David Kirby

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Course ID: ECE 440 Introduction to Computer Networks-Spring
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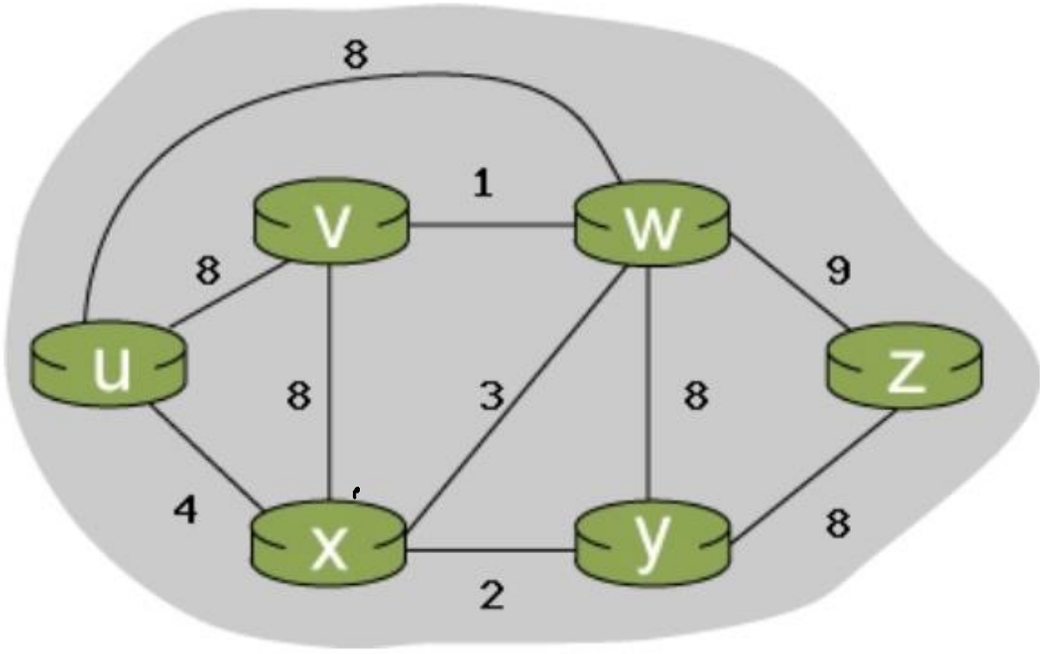
3262B/ Office Hours: Tuesdays and Thursdays 2:00pm-3:00pm
Lectures: Tuesdays and Thursdays 3:30pm-4:45pm
Department of Electrical and Computer Engineering / University of New Mexico

Final Exam

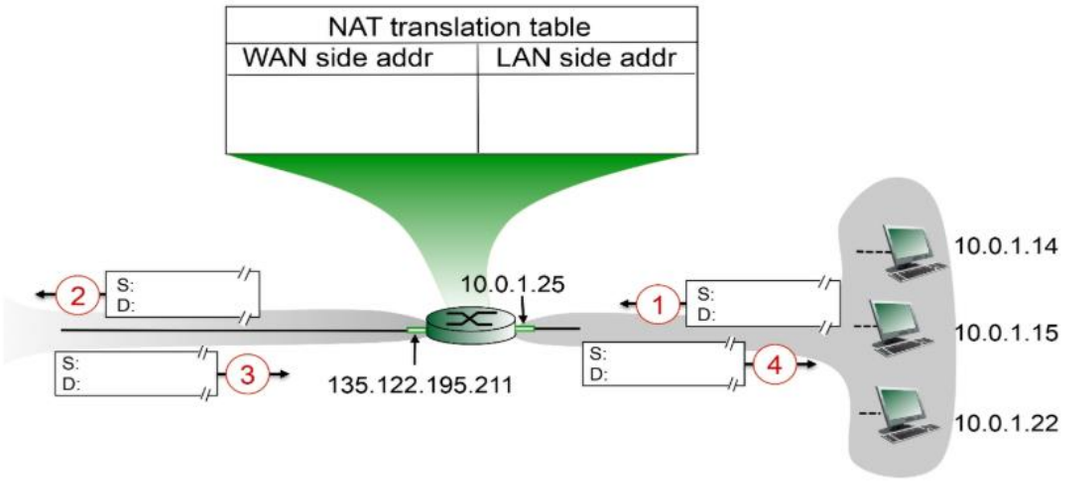
1. **(20%)** Consider the 6-node network shown below, with the given link costs.



Using Dijkstra's algorithm, find the least cost path from source node u to all other destinations. Show your work in tabular format.

2. **(20%)** Suppose that TCP's current estimated values for the round-trip time (estimatedRTT) and deviation in the RTT (DevRTT) are 330 msec and 19 msec, respectively. Suppose that the next three measured values of the RTT are 330, 220, and 0 respectively. Compute TCP's new value of estimatedRTT, DevRTT, and the TCP timeout value after each of these three measured RTT values is obtained. Use the values of $\alpha = 0.125$ and $\beta = 0.25$. Please show your intermediate calculations, so in case your final result is wrong, at least you can have some points from the intermediate steps.

3. **(20%)** Consider the scenario below in which three hosts, with private IP addresses 10.0.1.14, 10.0.1.15, 10.0.1.22 are in a local network behind a NATted router that sits between these three hosts and the larger Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.1.25, while the router's address on the Internet side has IP address 135.122.195.211.



Suppose that the host with IP address 10.0.1.15 sends an IP datagram destined to host 128.119.163.181. The source port is 3318, and the destination port is 80.

- Consider the datagram at step 1, after it has been sent by the host but before it has reached the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

- Now consider the datagram at step 2, after it has been transmitted by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram? Identify the differences in datagram's IP addresses and port numbers between step 1 and step 2. Specify the entry that has been made in the router's NAT table.

- Now consider the datagram at step 3, just before it is received by the NATted router. What are the source and destination IP addresses for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram?

- Last, consider the datagram at step 4, after it has been transmitted by the NATted router but before it has been received by the host. What are the source and destination IP address for this datagram? What are the source and destination port numbers for the TCP segment in this IP datagram? Identify the differences in datagram's IP addresses and port numbers between step 3 and step 4. Has a new entry been made in the router's NAT table, or removed from the NAT table? Explain your answer.

4. (1%) In a distance-vector routing algorithm, each node has a map of the entire network and determines the shortest path from itself to all other nodes in the network.

True / False

5. (1%) In the BGP routing algorithm, each AS advertises to its neighbors its estimates of the shortest distances from the AS to all possible destination ASs.

True / False

6. (1%) OSPF uses BGP for routing among areas.

True / False

7. (1%) Every autonomous system must use the same intra-autonomous system routing algorithm.

True / False

8. (1%) With a datagram network layer, each packet carries the address of the destination host.

True / False

9. (1%) Which one of the following is NOT a function of network layer?
a) routing
b) inter-networking
c) congestion control
d) error control

10. (1%) A 4 byte IP address consists of _____
a) only network address
b) only host address
c) network address & host address
d) network address & MAC address

11. (1%) Which of the following routing algorithms can be used for network layer design?
a) shortest path algorithm
b) distance vector routing
c) link state routing
d) all of the mentioned

12. (1%) The network layer protocol for internet is _____
a) ethernet
b) internet protocol
c) hypertext transfer protocol
d) file transfer protocol

13. (1%) ICMP is primarily used for _____
a) error and diagnostic functions
b) addressing
c) forwarding
d) routing

14. (1%)The data link layer takes the packets from _____ and encapsulates them into frames for transmission.
a) network layer
b) physical layer
c) transport layer
d) application layer

15. (1%) Which of the following tasks is not done by data link layer?
a) framing
b) error control
c) flow control
d) channel coding

16. (1%) Header of a frame generally contains _____

a) synchronization bytes
b) addresses
c) frame identifier
d) all of the mentioned

17. (1%) Which of the following is the multiple access protocol for channel access control?
a) CSMA/CD
b) CSMA/CA
c) Both CSMA/CD & CSMA/CA
d) TDMA
e) FDMA
f) CDMA

18. (1%) Which of the following field in IPv4 datagram is not related to fragmentation?
a) Flags
b) Offset
c) TOS
d) Identifier

19. (1%) The TTL field has value 10. How many routers (max) can process this datagram?
a) 11
b) 5
c) 10
d) 1

20. (1%) The data field cannot carry which of the following?
a) TCP segment
b) UDP segment
c) ICMP messages
d) SMTP messages

21. (1%) What should be the flag value to indicate the last fragment?
a) 0
b) 1
c) TTl value
d) Protocol field value

22. (1%) Which of these is not applicable for IP protocol?
a) is connectionless
b) offer reliable service
c) offer unreliable service
d) does not offer error reporting

23. (1%) Which field helps to check rearrangement of the fragments?
a) offset
b) flag
c) ttl
d) identifier

24. (1%)The size of an IP address in IPv6 is _____
a) 4 bytes
b) 128 bits
c) 8 bytes
d) 100 bits

25. (1%) The header length of an IPv6 datagram is _____
a) 10bytes
b) 25bytes
c) 30bytes
d) 40bytes

26. (1%) Which among the following features is present in IPv6 but not in IPv4?
a) Fragmentation
b) Header checksum
c) Options
d) Anycast address

27. (1%) Suppose two IPv6 nodes want to interoperate using IPv6 datagrams, but they are connected to each other by intervening IPv4 routers. The best solution here is _____
a) Use dual-stack approach
b) Tunneling
c) No solution
d) Replace the system

28. (1%) The computation of the shortest path in OSPF is usually done by _____
a) Bellman-ford algorithm
b) Routing information protocol
c) Dijkstra's algorithm
d) Distance vector routing

29. (1%) The combination of _____ and _____ is often termed the local address of the local portion of the IP address.
a) Network number and host number
b) Network number and subnet number
c) Subnet number and host number
d) Host number

30. (1%) Which multiple access technique is used by IEEE 802.11 standard for wireless LAN?
a) CDMA
b) CSMA/CA
c) ALOHA
d) CSMA/CD

31. (1%) Which one of the following event is not possible in wireless LAN?
a) collision detection
b) acknowledgement of data frames
c) multi-mode data transmission
d) connection to wired networks

32. (1%) To join the internet, the computer has to be connected to a _____
a) internet architecture board
b) internet society
c) internet service provider
d) different computer

33. (1%) Internet access by transmitting digital data over the wires of a local telephone network is provided by _____
a) leased line
b) digital subscriber line
c) digital signal line

d) digital leased line

34. (1%) ISP exchanges internet traffic between their networks by _____
a) internet exchange point
b) subscriber end point
c) isp end point
d) internet end point

35. (1%) Which of the following protocols is used in the internet?
a) HTTP
b) DHCP
c) DNS
d) DNS, HTTP and DNS

36. (1%) Internet works on _____
a) packet switching
b) circuit switching
c) both packet switching and circuit switching
d) data switching

37. (1%) Which protocol assigns IP address to the client connected in the internet?
a) DHCP
b) IP
c) RPC
d) RSVP

38. (1%) Home Access is provided by _____
a) DSL
b) FTTP
c) Cable
d) All of the mentioned

39. (1%) In the layer hierarchy as the data packet moves from the upper to the lower layers, headers are _____
a) Added
b) Removed
c) Rearranged
d) Modified

40. (1%) A _____ is the physical path over which a message travels.
a) Path
b) Medium
c) Protocol
d) Route

41. (1%) Two devices are in network if _____
a) a process in one device is able to exchange information with a process in another device
b) a process is running on both devices
c) a process is active and another is inactive

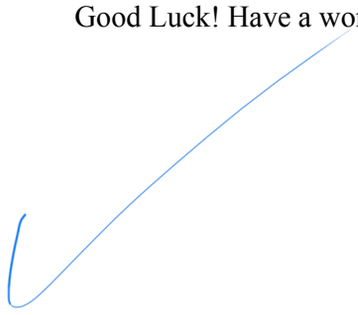
42. (1%) A _____ is a device that forwards packets between networks by processing the routing information included in the packet.
a) bridge
b) firewall
c) router

d) hub

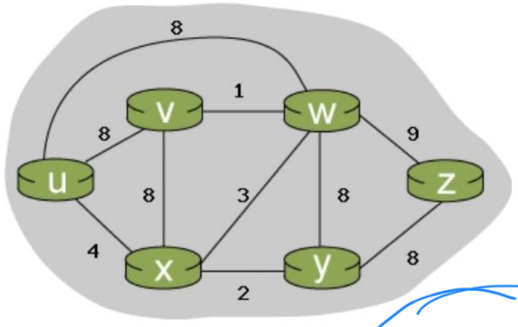
43. (1%) Write the layers of the IP stack.

Application
Transport
Network
Link
Physical

Good Luck! Have a wonderful summer! 😊



1. **(20%)** Consider the 6-node network shown below, with the given link costs.



Using Dijkstra's algorithm, find the least cost path from source node u to all other destinations.
Show your work in tabular format.

N'	D(u), P(u)	D(v), P(v)	D(w), P(w)	D(x), P(x)	D(y), P(y)	D(z), P(z)
u	—	8, u	8, u	4, u	∞	∞
ux	—	8, u	7, x	—	6, x	∞
uxy	—	8, u	7, x	—	—	14, y
uwxy	—	8, u	—	—	—	14, y
uvwxy	—	—	—	—	—	14, y
uvwxyz	—	—	—	—	—	—

2. (20%) Suppose that TCP's current estimated values for the round-trip time (estimatedRTT) and deviation in the RTT (DevRTT) are 330 msec and 19 msec, respectively. Suppose that the next three measured values of the RTT are 330, 220, and 0 respectively. Compute TCP's new value of estimatedRTT, DevRTT, and the TCP timeout value after each of these three measured RTT values is obtained. Use the values of $\alpha = 0.125$ and $\beta = 0.25$. Please show your intermediate calculations, so in case your final result is wrong, at least you can have some points from the intermediate steps.

estimated RTT = 330 ms $\alpha = 0.125$ $\beta = 0.25$

devRTT = 19 ms

est.RTT$_1$ = (1 − α) estimated RTT + α • Next measured RTT

= (1 − 0.125)(330 ms) + (0.125)(330 ms) = **330 ms**

est.RTT$_2$ = (1 − α) estimated RTT + α • Next measured RTT

(1 − 0.125)(330 ms) + (0.125)(220 ms) = **316.25 ms**

$$\text{est.RTT}_3 = (1-\alpha)\,\text{estimated RTT} + \alpha \cdot \text{Next measured RTT}$$

$$(1 - 0.125)(316.25\text{ms}) + (0.125)(0\ \text{ms}) = \boxed{276.72\ \text{ms}}$$

$$\text{DevRTT}_1 = \beta \cdot |\text{measured RTT}_1 - \text{est RTT}_1| + (1-\beta)\cdot \text{DevRTT}_0$$

$$= 0.25 \cdot |330\text{ms} - 330\text{ms}| + (0.75)\ 19\text{ms} = \boxed{14.25\text{ms}}$$

$$\text{DevRTT}_2 = \beta \cdot |\text{measured RTT}_2 - \text{est RTT}_2| + (1-\beta)\cdot \text{DevRTT}_1$$

$$= 0.25 \cdot |220\text{ms} - 316.25\text{ms}| + (0.75)14.25\text{ms} = \boxed{34.75\text{ms}}$$

$$\text{DevRTT}_3 = \beta \cdot |\text{measured RTT} - \text{est RTT}| + (1-\beta)\cdot \text{DevRTT}_2$$

$$= 0.25 \cdot |0\ \text{ms} - 316.25\text{ms}| + (0.75)34.75\text{ms} = \boxed{105.13\text{ms}}$$

$$\text{TimeoutInterval}_1 = \text{est.RTT}_1 + 4 \cdot \text{DevRTT}$$

$$= 330\text{ms} + 4(14.25\text{ms}) = \boxed{387.0\text{ms}}$$

$$\text{TimeoutInterval}_2 = \text{est.RTT}_2 + 4 \cdot \text{DevRTT}_2$$

$$= 316.25\text{ms} + 4(34.75\text{ms}) = \boxed{455.25\text{ms}}$$

$$\text{TimeoutInterval}_3 = \text{est.RTT}_3 + 4 \cdot \text{DevRTT}_3$$

$$= 276.72\text{ms} + 4(105.13\text{ms}) = \boxed{697.22\text{ms}}$$

-2

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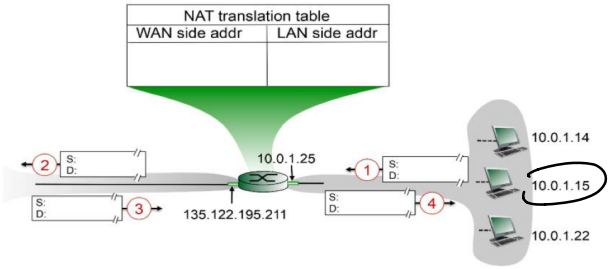

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135.122.195.211 → 10.0.1.15
: port 5309

Source port : 3318

dest. port : 80

? −6

	Source ID	Destination ID	Source Port	Dest. Port
step 1	10.0.1.15	128.119.163.181	3318	80
step 2	135.122.195.211	128.119.163.181	5309	80
step 3	128.119.163.181	135.122.195.211	80	5309
step 4	128.119.163.181	10.0.1.15	80	3318

The differences in the datagrams IP addresses are shown above A new entry has been made in the router's NAT table for 10.0.1.15.